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PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2003-261880**

(43)Date of publication of application : **19.09.2003**

(51)Int.Cl. **C10G 1/10**
C08J 11/12
F23G 7/12
// F27B 17/00
F27D 7/02
F27D 7/06

(21)Application number : **2002-064075**

(22)Date of filing : **08.03.2002**

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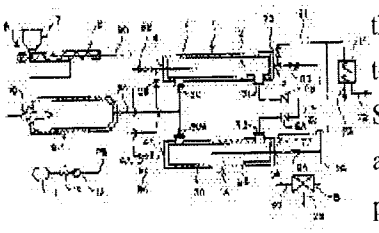
(54) **THERMAL DECOMPOSITION METHOD FOR PLASTIC AND THERMAL DECOMPOSITION SYSTEM**



(57)Abstract:

PROBLEM TO BE SOLVED: To achieve continuous operation without receiving the effect of a residue discharge process when a plastic is heated in the absence of oxygen in a thermal decomposition apparatus to be continuously subjected to thermal decomposition.

SOLUTION: A plurality of tubular thermal decomposition apparatuses (1 and 1A) not having screws therein are parallelly connected to be used. During a period when the operation of the thermal decomposition (1A) is stopped for the purpose of the discharge treatment of thermal decomposition residue, the thermal decomposition of the other thermal decomposition apparatus (1) is continued.

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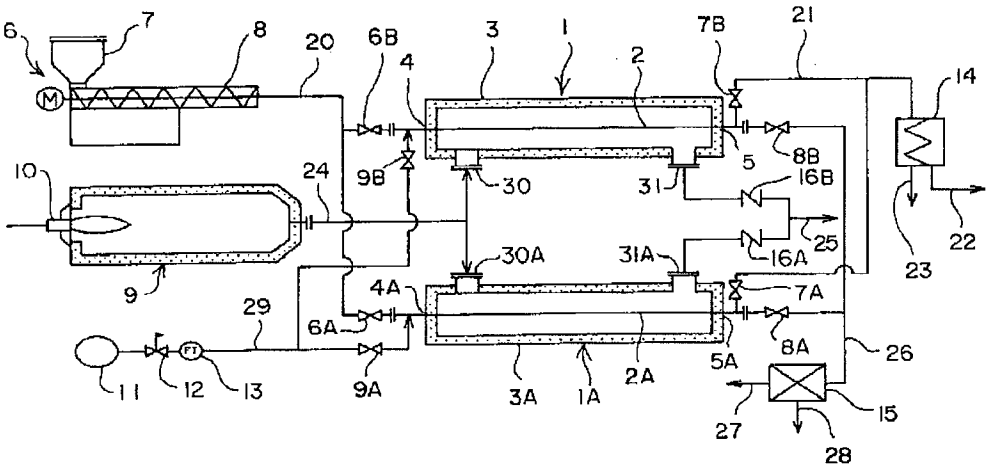
DRAWINGS

[Drawing 1]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the method and pyrolysis system which heat plastics, such as a waste plastic, under oxygen absence, and carry out a pyrolysis continuously with a pyrolysis device.
[0002]
[Description of the Prior Art]The plastics discharged from a factory or a home have various things, such as polyethylene (PE), polypropylene (PP), polystyrene (PS), and acrylic Butadiene Styrene (ABS). In order to collect useful components from these waste plastics as resources, many methods of carrying out a pyrolysis, condensing the gas constituents to generate, and collecting as oil under the absence of oxygen, are adopted.
[0003]In order to carry out the pyrolysis of the plastic, generally a pyrolysis device is used, but a tub type pyrolysis device and the pyrolysis device of a juxtaductal type are typical. A tub type pyrolysis device is provided with the tubed tub main part by which the pars basilaris ossis occipitalis was formed in the cone form, and the heating unit arranged at the circumference, and the throwing part of a plastic and the residue discharge part which discharges the residue generated by a pyrolysis at the gas discharge section which discharges production gas, and the pars basilaris ossis occipitalis are provided up, respectively.
[0004]If a pyrolysis is continued, residue and a caulking will stagnate in the pars basilaris ossis occipitalis of a tub main part, but since it will become causes, such as reduction in content volume, and pyrolysis degradation, if such residue increases, it scratches periodically with a rotation scraper and discharges from a residue discharge part. A tub type pyrolysis device has a small heat transfer area per capacity. However, since the long holding time of the plastic within a tub main part can be taken, continuous running is also possible although it is suitable when you need holding time to some extent, and operated mainly with a batch method.

[0005]The pyrolysis device of the juxtaductal type is provided with the heating unit arranged at a long and slender tubed coil and its circumference, while the plastic supplied to one end of the heated coil passes an inside, the pyrolysis of it is gradually carried out under the absence of oxygen, and production gas discharges it from the other end.The pyrolysis device of a juxtaductal type has a large heat transfer area per capacity, a device is miniaturized, and it has the advantage that pyrolysis speed is also high, and fits especially continuous running.
[0006]Continuous running of the pyrolysis device of a juxtaductal type will adhere or store up residue in the inside of a coil gradually. Since such residue bars the heat transfer from a heating unit and they reduce pyrolysis performance, it is necessary to discharge outside at a suitable interval. There are two sorts, the type which has a screw inside a coil, and the type which it does not have, in the pyrolysis device of a juxtaductal type. The type which has the former screw suspends operation periodically, and discharges the residue accumulated in the inside of a coil between them by a screw revolution. Thus, the type which has a screw can discharge residue easily. However, since this type installs a long and slender screw in the inside of a coil, a device is complicated, apparatus cost and operating cost become high, and there is demerit in which reaction volumes decrease by a screw.
[0007]On the other hand, many of these problems are not generated by the type which does not have the latter screw. However, discharge of the residue accumulated into the coil becomes difficulty from a screw type. As an extrusion method of the residue in this type, after stopping operation, for example, the cover plate of the end of a coil is removed, and there is the method of inserting in an inside the cleaning tool which attached the brush and the spatula at the tip, and discharging it. After carrying out a plant shutdown, the inside of a coil is changed into a high-temperature-oxidation state, residue is oxidized, and there is the method of discharging the oxide which subsequently carried out embrittlement by oxidation by an air blow etc. Although the latter method needs the comparatively small air blower for oxidation, etc., since discharge of residue can be performed simple, without disassembling a coil, it is a desirable method.
[0008]
[Problem(s) to be Solved by the Invention]The pyrolysis device of the juxtaductal type fits continuous running, and carries out continuous running also in a commercial plant in many cases. However, even if it is a pyrolysis device of a juxtaductal type, discharge operation of internal residue is periodically needed, and operation of the pyrolysis device of a plastic must be stopped in the meantime.
[0009]After replacing an inside by inactive gas, such as nitrogen gas, for carrying out re operation of the pyrolysis device furthermore, it is necessary to go up to prescribed temperature. Therefore, plant shutdown time became quite long, and since it was repeated periodically, it caused [main] a productivity slowdown of the pyrolysis. Then, this invention

solves a technical problem the starting problem, and it aims at providing the new pyrolytic process and pyrolysis system which use the pyrolysis device of a juxtaductal type.

[0010]

[Means for Solving the Problem]The 1st invention that solves said technical problem is the method of heating a plastic under oxygen absence and carrying out a pyrolysis continuously with a pyrolysis device. While this method uses a pyrolysis device of a juxtaductal type which does not have a screw for an inside to two or more parallel, connecting and stopping operation of one pyrolysis device for discharge processing of a thermal decomposition residue, a pyrolysis is continued with the pyrolysis device of another side (claim 1).

[0011]The 2nd invention that solves said technical problem is a system which heats a plastic under oxygen absence and carries out a pyrolysis continuously with a pyrolysis device. This system is provided with a pyrolysis device of two or more juxtaductal types with which it does not have a screw inside, a plastic feed unit which supplies a plastic to each pyrolysis device, a condenser which condenses production gas which carried out the pyrolysis, and a gas supply device which supplies gas containing oxygen to each pyrolysis device. And an opening and closing means is provided in a plastic supply route which connects between said plastic feed unit and each pyrolysis device, production gas exhaust passage which connects a condenser with said pyrolysis device, and a gas feed path which connects said gas supply device and each pyrolysis device, respectively (claim 2).

[0012]

[Embodiment of the Invention]Next, a drawing explains an embodiment of the invention. Drawing 1 is a process flow chart of the system which enforces the pyrolytic process concerning this invention. As for 1 and 1A, a coil, and 3 and 3A among a figure a pyrolysis device, and 2 and 2A A heating unit, 4 and 4A induction, and 5 and 5A a discharge part and 6 A plastic feed unit, As for an extrusion part and 9, a burner and 11 for 7 a heating gas feed unit and 10 a hopper and 8 A gas supply device, An adjustment device and 13 for 12 a flow instrument and 14 a condenser and 15 A dust collection device, 6B-9B, 6A-9A -- an opening and closing means, and 16B and 16A -- as for piping or a duct, and 29, a plastic supply route and 21 are [a heating gas admission-into-a-club mouth, and 31 and 31A of a gas feed path, and 30 and 30A] heating gas exit parts production gas exhaust passage, and 22-28 a flow control means and 20.

[0013]Although the pyrolysis system shown in drawing 1 carries out multiple connection of 2 sets of pyrolysis devices 1 and 1A and it is constituted, multiple connection of the 3 or more sets can also be carried out. The pyrolysis device 1 has the heating unit 3 arranged so that the circumference of the coil 2 and the coil 2 of the juxtaductal type formed in tubed [long and slender] may be covered. The coil 2 of the shape of a long and slender straight cylinder is made from a thermally conductive good metallic material, the induction 4 of a plastic is formed

in the end of one of these, and the discharge part 5 of production gas is formed in the end of another side. And while moving the inside of the coil 2, the pyrolysis of the plastic introduced from the induction 4 is carried out, and production gas discharges it from the discharge part 5.
[0014]The heating unit 3 has the telescopic heat chamber surrounded with the adiabatic wall, and the heating gas exit part 31 is formed near [induction 4] the coil 2 to the heating gas inlet section 30 and discharge part 5 neighborhood, respectively.And the heating gas inlet section 30 is connected to the heating gas feed unit 9 by the piping 24, and the heating gas exit part 31 is connected to a flue gas treatment apparatus (not shown) through the duct 25. Other pyrolysis devices 1A as well as the above-mentioned pyrolysis device 1 are constituted. Therefore, the suffix A is given to the same portion as the pyrolysis device 1 after the same number, and the overlapping explanation is omitted.
[0015]In order to supply a plastic to 2 sets of pyrolysis devices 1 and 1A, the common plastic feed unit 6 is formed. The hopper 7 which receives the plastic piece which the plastic feed unit 6 could use the extrusion machine generally used for the injection molding of a plastic, and was finely ground with the grinding apparatus (not shown), It has the extrusion part 8 which carries out heat melting of the plastic piece supplied by the feeding means from the hopper 7 with an electric heater etc., and is extruded on a screw. The molten plastic discharged from the extrusion part 8 is supplied to the coils 2 and 2A of the pyrolysis devices 1 and 1A through the plastic supply route 20 in which the opening and closing means 6B and 6A, such as an opening and closing valve, were formed. The outside of the plastic supply route 20 is covered with a thermal break.
[0016]In order to supply heating gas to the heating units 3 and 3A of 2 sets of pyrolysis devices 1 and 1A, the common heating gas feed unit 9 is formed. The burner 10 is formed in the heating gas feed unit 9, and the hot combustion gas produced by burning by the burner 10 in liquid fuel or gaseous fuel is supplied to the heating gas inlet sections 30 and 30A in the heating units 3 and 3A of each pyrolysis device 1 through the piping 24. And the flow of the heating gas supplied to the heating units 3 and 3A is adjusted with the flow control means 16B and 16A of the adjustment damper etc. which were formed in the duct 25 connected to the heating gas exit parts 31 and 31A. The burner 10 of the heating gas feed unit 9 can burn gaseous fuel, such as low boiling point components etc. of 1 or the production gas which is formed two or more and is not condensed with liquid fuel, such as a fuel oil, or the condenser 14 mentioned later, or these both.
[0017]The production gas which flows out of the discharge parts 5 and 5A of 2 sets of pyrolysis devices 1 and 1A is introduced into the common condenser 14 through the production gas exhaust passage 21. The condenser 14 has a heat exchanging part which carries out heat exchange of a cooling medium and production gas, such as cooling water, Liquid components, such as a condensed monomer, are collected by the recovery tank which is not illustrated from

the piping 22, and are used as resources, and the low boiling point components which are not condensed are supplied to the burner 10 of the incinerator which is not illustrated from the piping 23, or the heating gas feed unit 9.

[0018]In one dormant period of 2 sets of pyrolysis devices 1 and 1A, in order to oxidize the residue accumulated in the coils 2 and 2A, the gas supply device 11 for supplying gas containing oxygen, such as air, is formed. The gas supply device 11 is constituted by the comparatively small air blower etc., and the flow control means 12 and the flow instruments 13, such as a regulating valve, are formed in the outlet side. The outlet side of the flow instrument 13 is connected to the coils 2 and 2A of each pyrolysis devices 1 and 1A by the gas feed path 29 which established the opening and closing means 9B and 9A, such as an opening and closing valve.

[0019]Next, although how to carry out the pyrolysis of the plastic by the pyrolysis system of drawing 1 is explained, the pyrolysis device 1 is operated first and the pyrolysis device 1A describes the case where it has stopped for the discharge processing (cleaning treatment) of residue. For operating the pyrolysis device 1, the opening and closing means 7B is opened first, and it changes into the state where inactive gas, such as nitrogen gas, replaces the channel from the pyrolysis device 1 to the condenser 14, and oxygen does not exist as a state which closed the opening and closing means 6B, 8B, and 9B.

[0020]Pressure reducing devices, such as a vacuum pump, can be connected to these courses depending on the case, and it can also be considered as a reduced pressure state. For example, when carrying out the pyrolysis of the polystyrene and generating a styrene monomer, If a pyrolysis is decompressed and carried out to about 20Torr-100Torr in 350 ** - about 700 **, the generation rate of by-products, such as a styrene dimer, a styrene trimer, or ethylbenzene, can be controlled, and the generation rate of styrene which is an object can be raised.

[0021]About 800 ** heating gas is supplied to the heating unit 3 from the heating gas feed unit 9, and the temperature of the coil 2 is raised. Although the temperature of the coil 2 is set as the optimal range by the kind of plastic which should be carried out a pyrolysis, the flow control means 16B of the damper etc. which were formed in the duct 25 performs the adjustment. For example, when carrying out the pyrolysis of polystyrene, it is usually set as a temperature requirement (350 ** - about 700 **) as mentioned above, but the highest possible pyrolysis temperature for making pyrolysis speed high is preferred. However, since the generation rate of a by-product will increase and the generation ratio of residue will also increase further if pyrolysis temperature is made high too much, it is stopped by about 700 **.

[0022]On the other hand, in the plastic feed unit 6, heat melting of the plastic shall be carried out in 150 ** - about 300 **, and it shall be in the state where a molten plastic can be supplied from the extrusion part 8. And if the temperature of the coil 2 reaches prescribed temperature

as mentioned above, the opening and closing means 6B will be opened, a molten plastic will be continuously supplied to the induction 4 of the coil 2 from the extrusion part 8, and a pyrolysis will be started. While passing the coil 2, the pyrolysis of the molten plastic is carried out gradually, depolymerize of it is carried out and it evaporates. A reaction is started, after a while, discharge of production gas begins from the discharge part 5 of the coil 2 in the production gas exhaust passage 21, it is cooled with the condenser 14, and the production gas is condensed and liquefied. The liquefied oil components are collected by the recovery tank which is not illustrated through the piping 22, and the low boiling point components which are not condensed are supplied to the burner 10 grade of a combustion furnace or the heating gas feed unit 9 as mentioned above. Thus, the pyrolysis of the plastic is continuously carried out by the pyrolysis device 1.

[0023]On the other hand, operation which discharges the residue which accumulated the pyrolysis device 1A under pause into the coil 2A is performed. In this example, residue is oxidized, it discharges for the piping 26 from the discharge part 5A, and the dust collection devices 15, such as a bag filter type or a cyclone separator type, remove a minerals ingredient. The gas constituents separated with the dust collection device 15 are discharged outside from the piping 27, and minerals are collected from the piping 28 to a collection tank etc.

[0024]As a premise, the pyrolysis device 1A assumes that residue is being accumulated into the hot coil 2A, as a result of performing the pyrolysis of a plastic continuously before it. When the plastic supplied to the coil 2A is a waste plastic, the yield of residue is about 1% of the weight of a supply plastic. On the occasion of oxidation treatment, from pyrolysis temperature, it is desirable to carry out by lowering by about 600 **, and the temperature control performs internal temperature of the coil 2A by adjustment of the flow control means 16A provided in the duct 25.

[0025]A residue discharging process closes the opening and closing means 6A and 7A, is in the state which opened the opening and closing means 8A and 9A, and supplies gas containing oxygen, such as air, to the coil 2A according to the gas feed path 29 from the gas supply device 11. The flow of this gas containing oxygen adjusts the flow control means 12, such as a regulating valve, with surveillance, and performs the flow instrument 13. And the gas which passed the coil 2A is discharged to the dust collection device 15 from the piping 26 which formed the opening and closing valve 8A as mentioned above.

[0026]The inside of the coil 2A which introduced gas containing oxygen will be in a high-temperature-oxidation state, and oxidation treatment of the residue which exist there will be carried out efficiently. The organic matter in residue reacts to oxygen, and it is decomposed into carbon dioxide (CO_2) or water (H_2O), and accompanies to a gas, and it discharges from the discharge part 5A, and capacity contracts and the ingredient which cannot be decomposed remains as parts for minerals, such as ash, sand, and a metal piece. And also about the

caulking which adhered in a coil 2A wall strongly, it secedes from the organic matter contained in it by decomposition, and embrittlement of the part for minerals is carried out when reducing, and it can weaken the adhesion force.

[0027]If oxidation treatment is completed, the flow control means 16A will be closed and the heating unit 3A will be cooled to near ordinary temperature. Simultaneously with a cooling start, a part for the minerals which remains in the coil 2A is discharged from the piping 26 to the dust collection device 15 by an air blow etc. after cooling. A part for the minerals separated with the dust collection device 15 is discharged from the piping 28, and gas constituents are discharged from the piping 27. The air blow can connect a blow pipeline to the coil 2A, and can also be performed. If discharge operation is completed, inactive gas will replace the inside of the coil 2A, the heating gas supply to the heating unit 3A is resumed further, and the internal temperature of the coil 2A is gone up to reaction temperature.

[0028]On the other hand into the coil 2 of the pyrolysis device 1 which is continuing the pyrolysis, residue is accumulated gradually, and pyrolysis capability declines according to it. When the residue of the specified quantity is accumulated into the coil 2, the pyrolysis device 1 is switched to a residue discharging process from pyrolysis operation, and the pyrolysis device 1A is switched to a pyrolysis process.

[0029]Such switching operation closes the opening and closing means 6B and 7B first, opens the opening and closing means 6A and 7A, switches the molten plastic of the plastic feed unit 6 to the coil 2A from the coil 2, and switches introduction of the production gas to the condenser 14 to the coil 2A from the coil 2 with it. The discharging process of the residue in the coil 2 of the pyrolysis device 1 which carried out the plant shutdown is performed like the residue discharging process in the coil 2A of said pyrolysis device 1A.

[0030]Said embodiment has attained continuous pyrolysis operation of a plastic by carrying out multiple connection of 2 sets of pyrolysis devices 1 and 1A, and switching them to a pyrolysis process and a residue discharging process by turns. However, 3 or more set multiple connection not only of this but the pyrolysis device can be carried out, and as there are always at least 1 set of pyrolysis devices in a pyrolysis process, it can also operate.

[0031]

[Effect of the Invention]As mentioned above, while the pyrolytic process of the plastic concerning this invention uses the pyrolysis device of the juxtaductal type which does not have a screw for an inside to two or more parallel, connecting and stopping operation of one pyrolysis device for the discharge processing of a thermal decomposition residue, a pyrolysis is continued with the pyrolysis device of another side. According to this pyrolytic process, irrespective of a residue discharging process, the continuous pyrolysis of a plastic can be attained and the productivity can be improved remarkably. According to the pyrolysis system of the plastic concerning this invention, the above-mentioned pyrolytic process can be enforced

suitably.

[Translation done.]